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Low - Speed Engines 2015



COMMON-RAIL

RT-FLEX

GENERATION X

LOW PRESSURE X-DF

LOW-SPEED ENGINE

Diesel United - WÄRTSILÄ
Low - Speed Engines 2015

株式会社 ディーゼル ユナイテッド
DIESEL UNITED, LTD.

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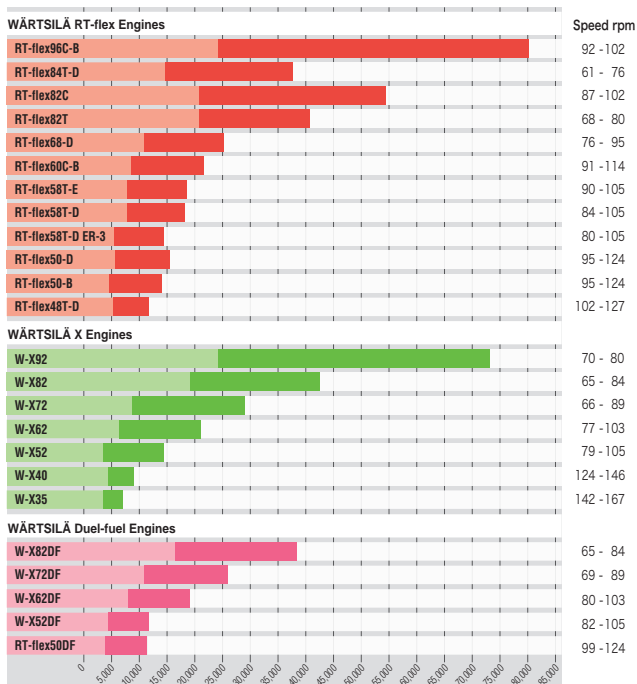
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出力範囲

Power Range

Power Range for DU-Wärtsilä Low-Speed Engines



WÄRTSILÄ 低速エンジンの特長

Features of Wärtsilä low speed engine

1. 低燃費と低 NOx 排出率の両立

Consistent of lower FOC and lower NOx emission

- ・ コモンレール技術による先進の燃料噴射方式
Advanced fuel injection by common-rail technology
- ・ 低負荷連続運転への適用性
Easier to apply lower load operation

2. 15 年以上の実績と確立した信頼性

Well confirmed reliability by more than 15 years experience

- ・ 電子制御式低速エンジンの先駆者として世界をリードし、最も長い豊富な実績を持つ
Longest track record for electrically-controlled low-speed common-rail engines in the world.

3. シンプルな構造

Simple and reliable structure

- ・ コモンレール技術採用
Common-rail technology applied
- ・ 油圧生成部と制御部分を分離
Simple and flexible control by separated hydraulic and control parts

4. スマートかつシンプルな制御システム

Smart and simple control concept

- ・ 制御モジュールは 1 種類のみ (RT-flex)
Only one kind of computer module (RT-flex)
- ・ シンプルで汎用性の高い制御モジュール (W-X)
Simple and versatile computer module (W-X)

5. 自動状態診断システム LC-A との親和性

Bigger synergy effect with LC-A

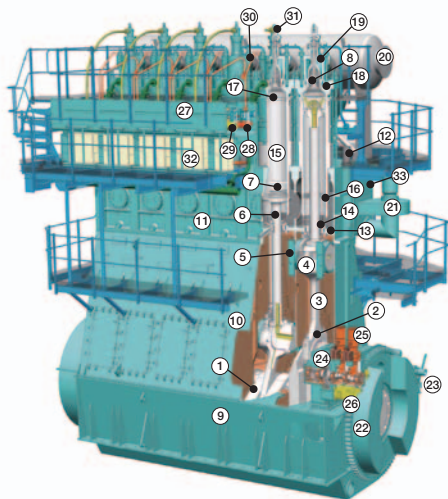
- ・ 自動状態診断による予防保全
Preventive maintenance by the automatic condition diagnosis
- ・ 迅速かつ的確なトラブルシューティング
Quick and exact troubleshooting
- ・ 状態に基づいた最適運転航設定
Optimum operation setting based on the actual condition



WÄRTSILÄ 低速エンジンの構造

Structure of WÄRTSILÄ low speed engine

WÄRTSILÄ RT-flex LOW-SPEED MARINE ENGINES



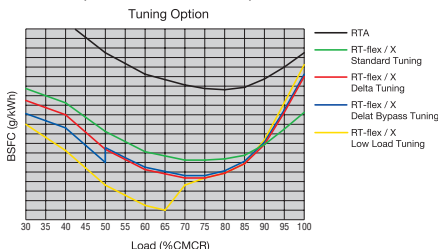
- | | | |
|---------------------------------|-----------------------------------|---|
| 1. Crankshaft | 13. Diaphragm | 25. High-pressure fuel supply pumps |
| 2. Bottom end of connecting rod | 14. Piston rod gland | 26. Servo oil pumps |
| 3. Connecting rod | 15. Cylinder liner | 27. Rail unit |
| 4. Crosshead | 16. Scavenge air ports | 28. Fuel oil rail with injection control units |
| 5. Crosshead guide shoes | 17. Anti-Polishing Ring | 29. Servo oil rail with exhaust valve control units |
| 6. Piston rod | 18. Cylinder cover | 30. High-pressure pipes to fuel injection valves |
| 7. Piston | 19. Exhaust valve cage | 31. Exhaust valve drive |
| 8. Exhaust valve | 20. Exhaust manifold | 32. Electronic cabinets |
| 9. Bedplate | 21. Auxiliary scavenge air blower | 33. Scavenge air receiver |
| 10. Column | 22. Flywheel | |
| 11. Cylinder block | 23. Turning gear | |
| 12. Tie rods | 24. RT-flex supply unit | |

WÄRTSILÄ 低速エンジンの性能

Performance of WÄRTSILÄ low speed engine

RT-flex および W-X 電子制御エンジンは、船舶の運航形態に合わせ、様々なチューニングを行うことができ、本船の燃料消費量削減に貢献することができます。

RT-flex and W-X electronically controlled engines can contribute fuel saving by a various tuning option to meet the actual operation of individual ship.



デルタチューニング

Delta Tuning

主に常用負荷域での燃費向上を狙うチューニングです。ソフトウェアのパラメーターの変更のみで対応可能となります。

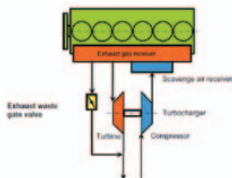
This is the tuning for improvement of fuel consumption at normal engine load. It is possible only to optimize the parameter of software.

デルタバイパスチューニング

Delta Bypass Tuning

デルタチューニングにおける燃費率を悪化させる事なく、より高い排気ガス温度と、それによる蒸気発生量の増加を狙うチューニングです。排気ガスバイパス弁を設ける事が必要となります。

Delta Bypass Tuning is an engine tuning designed for increasing the exhaust gas temperature and steam production power without any penalty to the engine specific fuel consumption and performance while still complying with all existing emission legislation. Delta Bypass Tuning is achieved by adding one exhaust gas waste gate.



ローロードチューニング

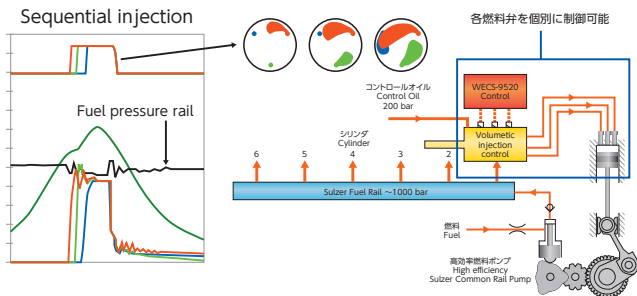
Low Load Tuning

エンジン低負荷域での燃費性能を重視するチューニングです。排気バイパス弁を設け、高負荷域での過給機オーバースピードを抑えます。

This is the tuning for improvement of fuel consumption at low engine load. The exhaust waste gate can prevent the turbocharger overspeed at high engine load.

シーケンシャル燃料噴射による NOx 削減 NOx Reduction by Sequential Fuel Injection

- 低燃費率と低 NOx 排出率の両立を可能とするコモンレールシステムによる技術。
Common-rail technology can balance lower fuel consumption with further reduction of NOx emission.
- 高圧噴射による良好な燃焼を維持したまま、熱発生率を抑制。
It can control the heat release rate with keeping good combustion under high-pressure injection.
- RT-flex および W-X エンジンのみが実現可能な燃料噴射形態。
Only RT-flex and W-X engines can realize such a fuel injection system.

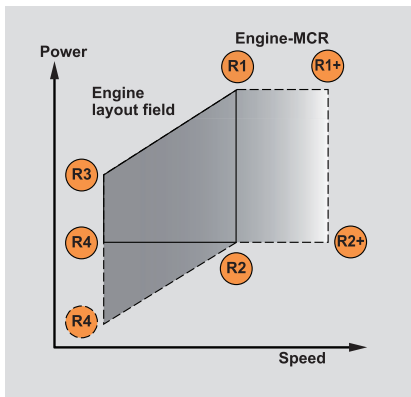


エンジンレーティング

Engine Rating

エンジンのレーティングは、出力および回転数により決められた R1, R2, R3 及び R4 ポイントの内側でエンジンの連続最大出力 (MCR) が設定されます。

The engine layout fields for DU-Wärtsilä low-speed engines are defined by the power/speed rating points R1, R2, R3 and R4.



ISO Standard Reference Condition

大気圧 (Barometric pressure)	1,000hPa
過給器ブロウ入口温度 (Suction air temperature)	25°C
相対湿度 (Relative humidity)	30%
空気冷却器冷却水温度 (Scavenge air cooling water temperature)	29°C

FUEL CONSUMPTION

All brake specific fuel consumptions (BSFC) are quoted for fuel of lower calorific value 42.7 MJ/kg, and for ISO standard reference conditions (ISO 15550 and 3046).

BSFC figures for Wärtsilä engines are given with a tolerance of +5% across 40–100% and +7% across 25–39% engine load.

For Wärtsilä X62/72/X82/92 & RT-flex58T-D ER-3, stepwise tolerances have been introduced for the brake specific fuel consumption (BSFC):

+5% tolerance for 100% to 85% engine load

+6% tolerance for 84% to 65% engine load

+7% tolerance for 64% to 25% engine load

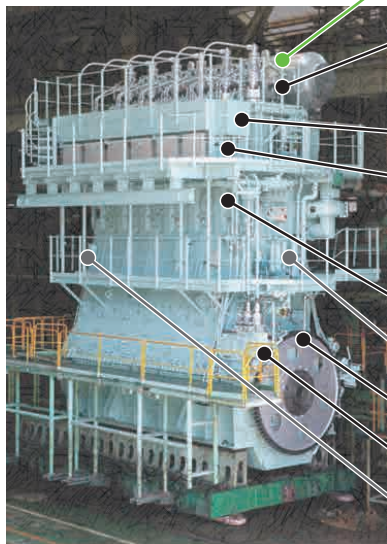
WÄRTSILÄ 低速エンジンの部品構成

WÄRTSILÄ low speed engine System Arrangement

RT-flex, X82, X92

X35 ~ X72

共通



シリンダ内圧自動調整システム
ICC

燃料弁
Fuel Injection valve

FAST nozzle

時間制御式 Time Controlled

レールユニット
Rail Unit

制御システム
Control System

WECS-9520

UNIC

パルスジェット注油
Pulse Lubricating System

自動逆洗オイルフィルタ
Automatic Back-wash Filter

クランクアングルセンサー
Crank Angle Sensor

サブライユニット
Supply Unit

機側操縦装置
Local Operation Box

Overview

WÄRTSILÄ 低速エンジンの部品構成

WÄRTSILÄ low speed engine System Arrangement

ICC

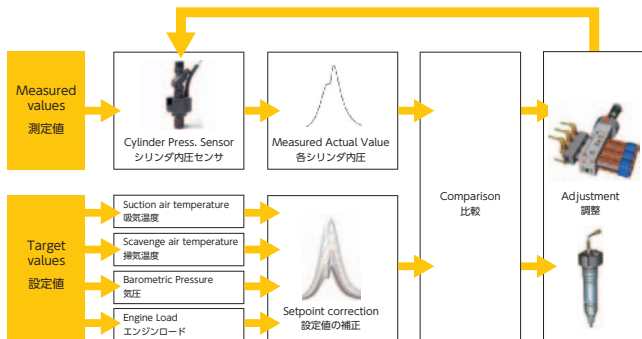
Intelligence Combustion Control

シリンダ内最高圧力 (Pmax) を自動調整し、燃料性状の悪化や周囲環境の変化による燃費の悪化を防ぎます。

ICC is the equipment optimizing the peak firing pressure (Pmax) automatically based on a set point. It can be prevented the fuel consumption aggravation that come from the degradation of fuel property and change of ambient environment.

仕組み Working principle

- ・ 指圧器弁に取り付けられたセンサからシリンダ内圧を常時監視
Sensor equipped on the indicator is always monitoring cylinder pressure.
- ・ データは制御システム (WECS, UNIC) にフィードバック
The data is fed back to the control system.
- ・ シリンダ内最高圧力 (Pmax) を自動調整
The peak firing pressure (Pmax) is optimized automatically.



燃料弁 Fuel Valve

FAST ノズル

Fuel Actuated Sacless Technology nozzle

従来型の燃料噴射弁は、燃料噴射後にノズル噴孔付近に燃料が一時的に残るため、これが燃料消費量悪化の要因の1つとなっていました。

FAST 弁は、噴孔付近の構造を改善することで燃料残油がなくなり、燃料消費量の向上が図れます。

The conventional fuel injection valve is set to one of the factors of the fuel consumption aggravation because a small amount of fuel remains near the injection nozzle temporarily after fuel injection.

The sac volume of FAST can be eliminated by improving the structure of fuel hole, and FAST can save fuel consumption.

特長 Features

- 約 1.0g/kWh の燃料消費率の低減
Reduction BSFC at approximately 1.0 g/kWh
- 炭化水素排出の低減抑制
Reduction of hydrocarbon emission
- 汚れの少ない燃焼室
Cleaner combustion chamber
- スモーク生成の低減
Reduction of smoke formation



時間制御式燃料弁

Time controlled fuel injection valve, with FAST nozzle

- 燃料噴射弁は FAST ノズルを踏襲
Following the FAST nozzle
- 時間制御燃料噴射弁
Time controlled fuel injection valves
- 噴射ノズルと制御を一つに集約
Intensive fuel nozzle and controlling



WÄRTSILÄ 低速エンジンの部品構成

WÄRTSILÄ low speed engine System Arrangement

レールユニット

Rail Unit

燃料噴射と排気弁開閉タイミングの最適制御により、燃費改善や環境性能を向上することができます。

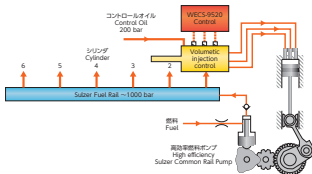
By the control of timing of fuel injection and exhaust valve, fuel consumption and the environmental advantage can be improved.

燃料噴射系 Fuel Injection

- 低負荷域でも高圧で燃料噴射可能
High injection pressure even at low speed
- 各シリンダの燃料弁を1本単位で制御
Control fuel injection for each fuel valve on each cylinder

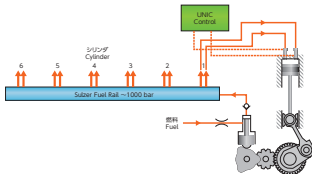
WECS

- 燃料噴射は WECS-9520 からの信号をレールバルブを介して制御
WECS-9520 system controls fuel valve action by rail valve



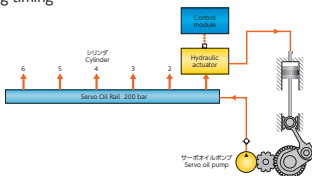
UNIC

- バルチラ 4 ストロークエンジンで豊富な実績
Many experiences on Wärtsilä 4 stroke engine
- X-DF エンジンに対応
Availability for the X-DF engine



排気弁駆動系 Exhaust Valve Driving

- 排気弁開閉タイミングを自由に制御可能
Free control for adjustment on opening-closing timing
- ストロークセンサによりフィードバック制御
Feedback control of exhaust valve by stroke sensor
- RTA エンジン同様、油圧で開き、空気圧で閉まります。
Reliable valve opening by hydraulic oil and valve closing by air spring same as in proven RTA engine

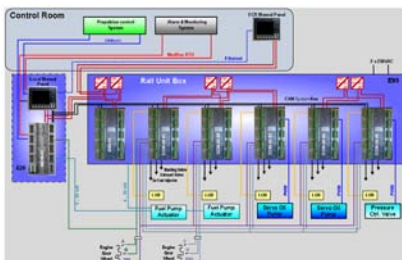


制御システム Control System

WECS

対応機種 / Application models : RT-flex, X82, X92

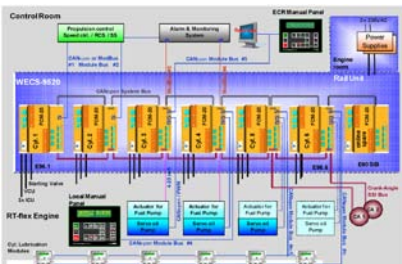
- FCM-20 制御モジュールを使用。 FCM-20 cylinder modules
- シリンダ油は別制御モジュール (ALM-20) で制御。
Control of cyl lubrication injection by another one (ALM-20)
- 電源ユニット E85 から電源供給。 External power supply from E85



UNIC

対応機種 / Application models : X35-X72

- CCM-20 制御モジュールを使用。 CCM-20 cylinder modules
- シリンダ油の制御を統合。 Control of cyl lubrication integrated



WÄRTSILÄ 低速エンジンの部品構成

WÄRTSILÄ low speed engine System Arrangement

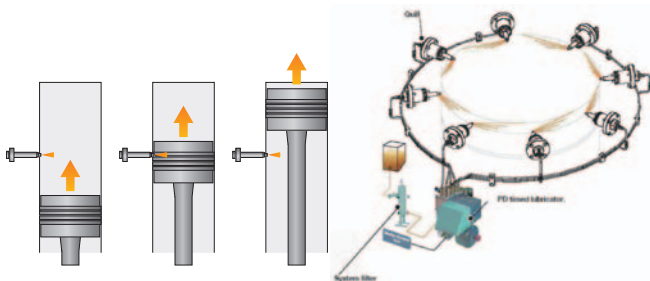
パルスジェット注油 Pulse Jet Lubricating System

パルスジェット注油は従来の蓄圧式注油より、さらなる注油率低減を目的として開発された電子式注油システムです。

Pulse jet lubricating system was developed for lower lubricating oil consumption compared with the accumulator system.

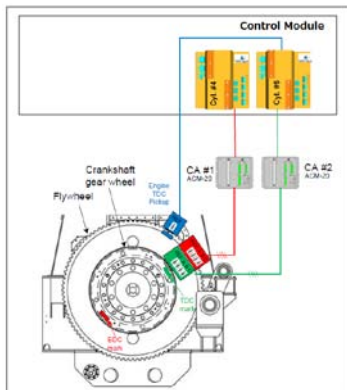
特長 Features

- 低負荷状態でも適正な注油が可能
Proper lubricating oil distribution even at low load operation
- 信頼性の高い注油ノズル
High reliable lubrication nozzle
- 電子制御による最適な注油タイミング
Optimized lubricating at the proper injection timing by the electronic control
- 効果的なライナ摺動面への注油
Effective lubricating on the liner wall
- 作動油はサーボオイルレールから供給できるため、特別な油圧源は不要
Hydraulic power supplied by flex servo-oil system. No supply unit or accumulator required



クランクアングルセンサ Crank Angle Sensor

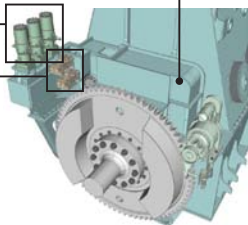
- CAS はクランクケース内に内蔵
CAS is built into crank case.
- センサは、エンコーダ型から接近
センサ型に変更
CAS sensor changed from encoder
type to proximity type.
- 交換が簡単
Simple procedure in case of pick up
replacement



クランクアングルセンサ
Crank Angle Sensor

燃料ポンプ
Fuel pump

サーボオイルポンプ
Servo oil pump



サプライユニット Supply Unit

- クランク軸付歯車を介して駆動
Drive by crankshaft gear
- 燃料とサーボオイルは一定圧力になるよう制御
Keep fuel and servo oil pressure in control.
- ポンプの1つが故障しても他のポンプで継続運転可能
In case of one fuel/servo oil pump broken, M/E can operate by another one.

WÄRTSILÄ RT-flex96C-B

Cylinder bore	960 mm
Piston stroke	2500 mm
Speed	92-102 rpm
Mean effective pressure at R1	18.6 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMK700

Rated power, principal dimensions and weights

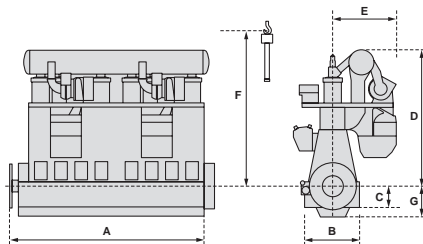
Cyl.	Output in kW at				Length A mm	Weight tonnes
	102 rpm		92 rpm			
	R1	R2	R3	R4		
6	34 320	24 000	30 960	24 000	12 240	1 160
7	40 040	28 000	36 120	28 000	13 920	1 290
8	45 760	32 000	41 280	32 000	16 510	1 470
9	51 480	36 000	46 440	36 000	18 190	1 620
10	57 200	40 000	51 600	40 000	19 870	1 760
11	62 920	44 000	56 760	44 000	21 550	1 910
12	68 640	48 000	61 920	48 000	23 230	2 050
13	74 360	52 000	67 080	52 000	24 910	2 160
14	80 080	56 000	72 240	56 000	26 590	2 300
Dimensions	B	C	D	E	F*	G
mm	4 480	1 800	10 925	5 380	12 950	2 594

Brake specific fuel consumption (BSFC) in g/kWh

Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		18.6	13.0	18.6	14.4
BSFC	Standard Tuning	172.0	166.0	172.0	166.0
Part load, % of R1		85	70	85	70
RT-flex tuning variant		Standard	Standard	Delta	Delta
BSFC		168.4	166.7	167.7	165.2
					Low-Load
					162.1

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* 13 and 14-cylinder engines are only available in RT-flex versions, and not in RTA versions.



WÄRTSILÄ RT-flex84T-D

Cylinder bore	840 mm
Piston stroke	3150 mm
Speed	61-76 rpm
Mean effective pressure at R1	19.0 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMk700

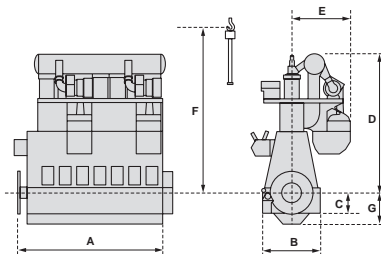
Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	76 rpm		61 rpm			
	R1	R2	R3	R4		
5	21 000	14 700	16 850	14 700	9 695	740
6	25 200	17 640	20 220	17 640	11 195	870
7	29 400	20 580	23 590	20 580	12 695	990
8	33 600	23 520	26 960	23 520	15 195	1 140
9	37 800	26 460	30 330	26 460	16 695	1 260
Dimensions mm	B	C	D	E	F*	G
	5 000	1 800	12 150	5 105	14 500	2 700

Brake specific fuel consumption (BSFC) in g/kWh

Full load						
Rating point		R1	R2	R3	R4	
BMEP, bar		19.0	13.3	19.0	16.6	
BSFC	Standard Tuning	171.0	165.0	171.0	167.0	
Part load, % of R1		85	70	85	70	65
RT-flex tuning variant		Standard	Standard	Delta	Delta	Low-Load
BSFC		167.4	165.7	166.7	164.2	161.1

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ RT-flex82C

Cylinder bore	820 mm
Piston stroke	2646 mm
Speed	87-102 rpm
Mean effective pressure at R1/R1+	20.0/19.0 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMK700

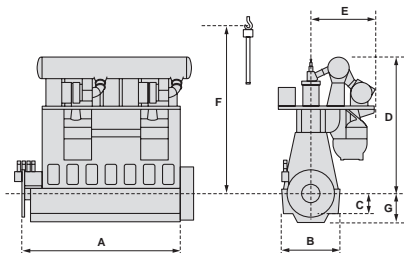
Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	97/102 rpm		87 rpm			
	R1/R1+	R2/R2+	R3	R4		
6	27 120	21 720	24 300	21 720	11 045	745
7	31 640	25 340	28 350	25 340	12 550	840
8	36 160	28 960	32 400	28 960	14 055	935
9	40 680	32 580	36 450	32 580	16 500	1 005
10	45 200	36 200	40 500	36 200	18 005	1 145
11	49 720	39 820	44 550	39 820	19 510	1 230
12	54 240	43 440	48 600	43 440	21 015	1 335
Dimensions	B	C	D	E	F*	G
mm	4 570	1 600	10 930	5 400	12 700	2 310

Brake specific fuel consumption (BSFC) in g/kWh

Full load						
Rating point		R1/R1+	R2/R2+	R3	R4	
BMEP, bar		20.0/19.0	16.0/15.2	20.0	17.9	
BSFC	Standard Tuning	173.0/171.0	167.0	173.0	170.0	
Part load, % of R1/R1+		85	70	85	70	65
RT-flex tuning variant		Standard	Standard	Delta	Delta	Low-Load
BSFC		169.4/167.4	167.7/165.7	168.7/166.7	166.2/164.2	163.1/161.1

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ RT-flex82T

Cylinder bore	820 mm
Piston stroke	3375 mm
Speed	68-80 rpm
Mean effective pressure at R1/R1+	20.0/19.0 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMk700

Rated power, principal dimensions and weights

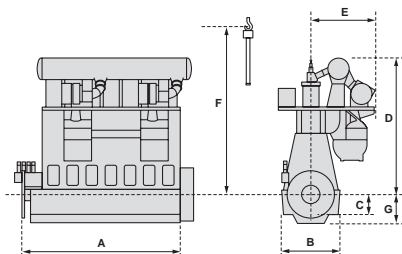
Cyl.	Output in kW at				Length A mm	Weight tonnes
	76/80 rpm		68 rpm			
	R1/R1+	R2/R2+	R3	R4		
6	27 120	21 720	24 300	21 720	11 045	812
7	31 640	25 340	28 350	25 340	12 550	917
8	36 160	28 960	32 400	28 960	14 055	1 028
9	40 680	32 580	36 450	32 580	16 500	1 167
Dimensions mm	B	C	D	E	F*	G
	5 320	1 800	12 250	5 400	14 820	2 700

Brake specific fuel consumption (BSFC) in g/kWh

Full load						
Rating point		R1/R1+	R2/R2+	R3	R4	
BMEP, bar		20.0/19.0	16.0/14.5	20.0	17.9	
BSFC	Standard Tuning	168.0/166.0	162.0	168.0	168.0	
Part load, % of R1/R1+		85	70	85	70	65
RT-flex tuning variant		Standard	Standard	Delta	Delta	Low-Load
BSFC		164.4/162.4	162.7/160.7	163.7/161.7	161.2/159.2	158.1/156.1

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Fast Nozzle applied as option.



WÄRTSILÄ RT-flex68-D

Cylinder bore	680 mm
Piston stroke	2720 mm
Speed	76-95 rpm
Mean effective pressure at R1	20.0 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMK700

Rated power, principal dimensions and weights

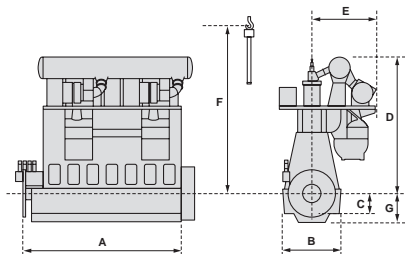
Cyl.	Output in kW at				Length A mm	Weight tonnes
	95 rpm		76 rpm			
	R1	R2	R3	R4		
5	15 650	10 950	12 500	10 950	7 530	386
6	18 780	13 140	15 000	13 140	8 710	439
7	21 910	15 330	17 500	15 330	9 890	496
8	25 040	17 520	20 000	17 520	11 070	552
Dimensions mm	B	C	D	E	F*	G
	4 320	1 520	10 400	4 700	12 545	2 340

Brake specific fuel consumption (BSFC) in g/kWh

Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		20.0	14.0	20.0	17.5
BSFC	Standard Tuning	170.0	164.0	170.0	166.0
Part load, % of R1		85	70	85	70
RT-flex tuning variant		Standard	Standard	Delta	Delta
BSFC		166.4	164.7	165.7	163.2
					Low-Load
					160.2

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Fast Nozzle applied as option.



WÄRTSILÄ RT-flex60C-B

Cylinder bore	600 mm
Piston stroke	2250 mm
Speed	91-114 rpm
Mean effective pressure at R1	20.0 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMk700

Rated power, principal dimensions and weights

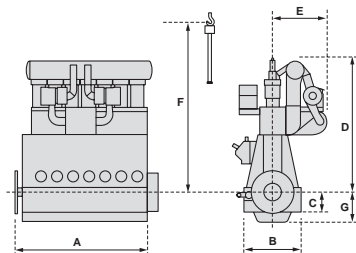
Cyl.	Output in kW at				Length A mm	Weight tonnes
	114 rpm		91 rpm			
	R1	R2	R3	R4		
5	12 100	8 450	9 650	8 450	6 638	268
6	14 520	10 140	11 580	10 140	7 678	322
7	16 940	11 830	13 510	11 830	8 718	377
8	19 360	13 520	15 440	13 520	9 758	428
9	21 780	15 210	17 370	15 210	10 798	480
Dimensions mm	B	C	D	E	F*	G
	3 700	1 300	8 570	3 660	10 500	1 955

Brake specific fuel consumption (BSFC) in g/kWh

Full load						
Rating point		R1	R2	R3	R4	
BMEP, bar		20.0	14.0	20.0	17.5	
BSFC	Standard Tuning	171.0	165.0	171.0	167.0	
Part load, % of R1		85	70	85	70	60
RT-flex tuning variant		Standard	Standard	Delta	Delta	Low-Load
BSFC		167.4	165.7	166.7	164.2	161.1

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Fast Nozzle applied as option.



WÄRTSILÄ RT-flex58T-E

Cylinder bore	580 mm
Piston stroke	2416 mm
Speed	90-105 rpm
Mean effective pressure at R1	21.0 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMk700

Rated power, principal dimensions and weights

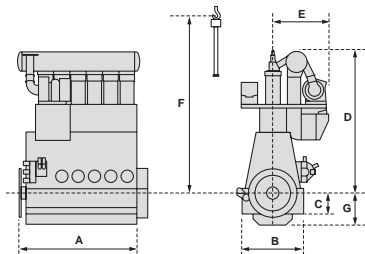
Cyl.	Output in kW at				Length A mm	Weight tonnes
	105 rpm		90 rpm			
	R1	R2	R3	R4		
5	11 750	7 900	10 075	7 900	6 381	281
6	14 100	9 480	12 090	9 480	7 387	322
7	16 450	11 060	14 105	11 060	8 393	377
8	18 800	12 640	16 120	12 640	9 399	418
Dimensions mm	B	C	D	E	F*	G
	3 820	1 300	8 822	3 475	10 880	2 000

Brake specific fuel consumption (BSFC) in g/kWh

Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		21.0	14.1	21.0	16.5
BSFC	Standard Tuning	168.0	162.0	168.0	162.0
Part load, % of R1		85	70	85	70
RT-flex tuning variant		Standard	Standard	Delta	Delta
BSFC		164.4	162.7	163.7	161.2
					Low-Load
					158.2

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* FAST Nozzle applied as standard.



WÄRTSILÄ RT-flex58T-D

Cylinder bore	580 mm
Piston stroke	2416 mm
Speed	84-105 rpm
Mean effective pressure at R1	20.2 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMk700

Rated power, principal dimensions and weights

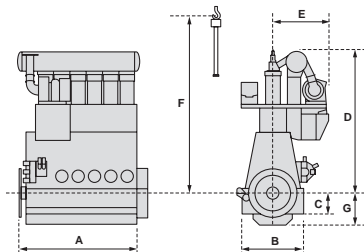
Cyl.	Output in kW at				Length A mm	Weight tonnes
	105 rpm		84 rpm			
	R1	R2	R3	R4		
5	11 300	7 900	9 050	7 900	6 381	281
6	13 560	9 480	10 860	9 480	7 387	322
7	15 820	11 060	12 670	11 060	8 393	377
8	18 080	12 640	14 480	12 640	9 399	418
Dimensions mm	B	C	D	E	F*	G
	3 820	1 300	8 822	3 475	10 880	2 000

Brake specific fuel consumption (BSFC) in g/kWh

Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		20.2	14.1	20.2	17.7
BSFC	RTA	173.0	167.0	173.0	169.0
	Standard Tuning	169.0	163.0	169.0	165.0
Part load, % of R1		85	70	85	70
RT-flex tuning variant		Standard	Standard	Delta	Delta
BSFC		165.4	163.7	164.7	162.2
					Low-Load
					159.2

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Fast Nozzle applied as option.



WÄRTSILÄ RT-flex58T-D ER-3

Cylinder bore	550 mm
Piston stroke	2416 mm
Speed	80-105 rpm
Mean effective pressure at R1	20.2 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMK700

Rated power, principal dimensions and weights

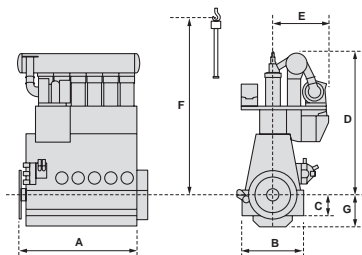
Cyl.	Output in kW at				Length A mm	Weight tonnes
	105 rpm		80 rpm			
	R1	R2	R3	R4		
5	10 175	7 100	7 750	5 400	6 381	281
6	12 210	8 520	9 300	6 480	7 387	322
7	14 245	9 940	10 850	7 560	8 393	377
Dimensions mm	B	C	D	E	F*	G
	3 820	1 300	8 822	3 475	10 880	2 000

Brake specific fuel consumption (BSFC) in g/kWh

Full load						
Rating point		R1	R2	R3	R4	
BMEP, bar		20.2	14.1	20.2	14.1	
BSFC	Standard Tuning	167.0	161.0	167.0	161.0	
Part load, % of R1		85	70	85	70	60
RT-flex tuning variant		Standard	Standard	Delta	Delta	Low-Load
BSFC		163.4	161.7	162.7	160.2	157.2

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* FAST Nozzle applied as standard.



WÄRTSILÄ RT-flex50-D

Cylinder bore	500 mm
Piston stroke	2050 mm
Speed	95-124 rpm
Mean effective pressure at R1	21.0 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMK700

Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	124 rpm		95 rpm			
	R1	R2	R3	R4		
5	8 725	6 650	6 700	5 100	5 576	200
6	10 470	7 980	8 040	6 120	6 456	225
7	12 215	9 310	9 380	7 140	7 336	255
8	13 960	10 640	10 720	8 160	8 216	280
9	15 705	11 970	12 060	9 180	9 096	315
Dimensions mm	B	C	D	E	F*	G
	3 150	1 088	7 646	3 570	9 270	1 636

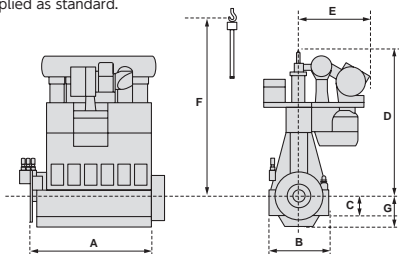
Brake specific fuel consumption (BSFC) in g/kWh

Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		21.0	16.0	21.0	16.0
BSFC	Standard Tuning	169.0	163.0	169.0	163.0
Part load, % of R1		85	70	85	70
RT-flex tuning variant		Standard	Standard	Delta	Delta
BSFC		165.4	163.7	164.7	162.2
					Low-Load
					159.2

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Aft-end turbocharger arrangement available.

* FAST Nozzle applied as standard.



WÄRTSILÄ RT-flex50-B

Cylinder bore	500 mm
Piston stroke	2050 mm
Speed	95-124 rpm
Mean effective pressure at R1	20.0 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMk700

Rated power, principal dimensions and weights

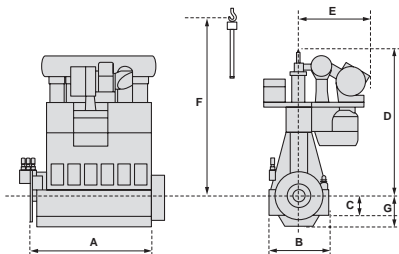
Cyl.	Output in kW at				Length A mm	Weight tonnes
	124 rpm		95 rpm			
	R1	R2	R3	R4		
5	8 300	6 325	6 375	4 850	5 576	200
6	9 960	7 590	7 650	5 820	6 456	225
7	11 620	8 855	8 925	6 790	7 336	255
8	13 280	10 120	10 200	7 760	8 216	280
Dimensions mm	B	C	D	E	F*	G
	3 150	1 088	7 646	3 570	9 270	1 636

Brake specific fuel consumption (BSFC) in g/kWh

Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		20.0	15.0	20.0	15.0
BSFC	Standard Tuning	170.0	164.0	170.0	164.0
Part load, % of R1		85	70	85	70
RT-flex tuning variant		Standard	Standard	Delta	Delta
BSFC		166.4	164.7	165.7	163.2
					Low-Load
					160.2

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* FAST Nozzle applied as standard.



WÄRTSILÄ RT-flex48T-D

Cylinder bore	480 mm
Piston stroke	2000 mm
Speed	102-127 rpm
Mean effective pressure at R1	19.0 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMK700

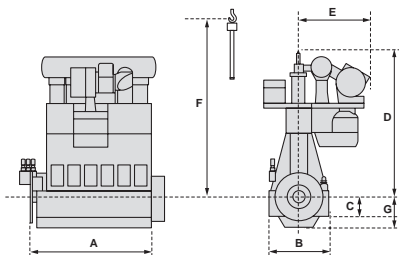
Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	127 rpm		102 rpm			
	R1	R2	R3	R4		
5	7 275	5 100	5 825	5 100	5 314	171
6	8 730	6 120	6 990	6 120	6 148	205
7	10 185	7 140	8 155	7 140	6 982	225
8	11 640	8 160	9 320	8 160	7 816	250
Dimensions mm	B	C	D	E	F*	G
	3 170	1 085	7 334	3 253	9 030	1 700

Brake specific fuel consumption (BSFC) in g/kWh

Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		19.0	13.3	19.0	16.6
BSFC	Standard Tuning	170.0	164.0	170.0	166.0
Part load, % of R1		85	70	85	70
RT-flex tuning variant		Standard	Standard	Delta	Delta
BSFC		166.4	164.7	165.7	163.2
					Low-Load
					160.2

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



Wärtsilä-X series

- RT-flex エンジンを踏襲
Following the common-rail technology
- 低回転、低燃費率を実現
Low speed and better low fuel consumption
- コンパクトかつ軽量のエンジン
Compact and lightweight engine
- X-DF 対応制御システム UNIC 採用
UNIC control system corresponding to X-DF engine applied



W7X82

WÄRTSILÄ X92

Cylinder bore	920 mm
Piston stroke	3468 mm
Speed	70-80 rpm
Mean effective pressure at R1/R1+	21.0/20.0 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMK700

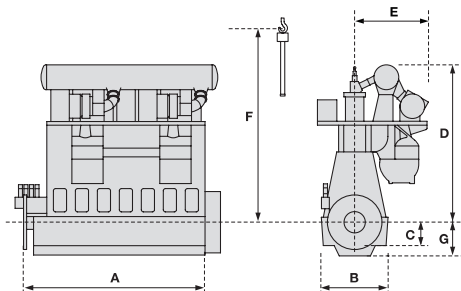
Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	76/80 rpm		70 rpm			
	R1/R1+	R2/R2+	R3	R4		
6	36 780	26 520	33 900	24 420	11 630	1 120
7	42 910	30 940	39 550	28 490	13 210	1 260
8	49 040	35 360	45 200	32 560	16 350	1 460
9	55 170	39 780	50 850	36 630	17 850	1 630
10	61 300	44 200	56 500	40 700	19 520	1 790
11	67 430	48 620	62 150	44 770	21 280	1 960
12	73 560	53 040	67 800	48 840	22 870	2 140
Dimensions	B	C	D	E	F*	G
mm	5 550	1 900	12 950	6 050	15 550	2 930

Brake specific fuel consumption (BSFC) in g/kWh

Full load					
Rating point		R1/R1+	R2/R2+	R3	R4
BMEP, bar		21.0/20.0	15.1/14.4	21.0	15.1
BSFC	Standard Tuning	166.0/165.0	159.0	166.0	159.0
Part load, % of R1/R1+		85	70	85	70
RT-flex tuning variant		Standard	Standard	Delta	Delta
BSFC		162.4/161.4	162.0/161.0	161.7/160.7	160.5/159.5
					Low-Load
					155.8/155.0

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ X82

Cylinder bore	820 mm
Piston stroke	3375 mm
Speed	65-84 rpm
Mean effective pressure at R1/R1+	21.0/19.0 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMK700

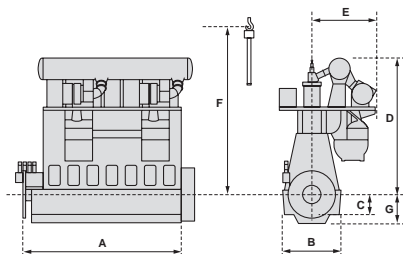
Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	76/84 rpm		65 rpm			
	R1/R1+	R2/R2+	R3	R4		
6	28 500	21 720	24 390	18 600	11 045	805
7	33 250	25 340	28 455	21 700	12 550	910
8	38 000	28 960	32 520	24 800	14 055	1 020
9	42 750	32 580	36 585	27 900	16 500	1 160
Dimensions mm	B	C	D	E	F*	G
	5 320	1 800	12 250	5 400	14 820	2 700

Brake specific fuel consumption (BSFC) in g/kWh

Full load					
Rating point		R1/R1+	R2/R2+	R3	R4
BMEP, bar		21.0/19.0	16.0/14.5	21.0	16.0
BSFC	Standard Tuning	165.0/163.0	158.0	165.0	158.0
Part load, % of R1/R1+	85	70	85	70	65
RT-flex tuning variant	Standard	Standard	Delta	Delta	Low-Load
BSFC	161.4/159.4	161.0/159.0	160.7/158.7	159.5/157.5	156.2/154.5

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ X72

Cylinder bore	720 mm
Piston stroke	3086 mm
Speed	66-89 rpm
Mean effective pressure at R1/R1+	20.5/19.4 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMK700

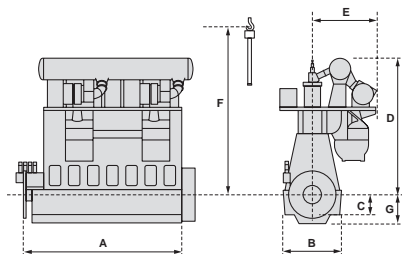
Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	84/89 rpm		66 rpm			
	R1/R1+	R2/R2+	R3	R4		
4	14 440	10 800	11 360	8 480	6 790	407
5	18 050	13 500	14 200	10 600	8 085	481
6	21 660	16 200	17 040	12 720	9 375	561
7	25 270	18 900	19 880	14 840	10 665	642
8	28 880	21 600	22 720	16 960	11 960	716
Dimensions	B	C	D	E	F*	G
mm	4 780	1 575	10 790	4 710	13 560	2 455

Brake specific fuel consumption (BSFC) in g/kWh

Full load						
Rating point		R1/R1+	R2/R2+	R3	R4	
BMEP, bar		20.5/19.4	15.4/14.5	20.5	15.4	
BSFC	Standard Tuning	167.0/166.0	160.0	167.0	160.0	
Part load, % of R1/R1+		85	70	85	70	65
RT-flex tuning variant		Standard	Standard	Delta	Delta	Low-Load
BSFC		163.4/162.4	163.0/162.0	162.7/161.7	161.5/160.5	158.2/157.4

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ X62

Cylinder bore	620 mm
Piston stroke	2658 mm
Speed	77-103 rpm
Mean effective pressure at R1/R1+	20.5/19.3 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMK700

Rated power, principal dimensions and weights

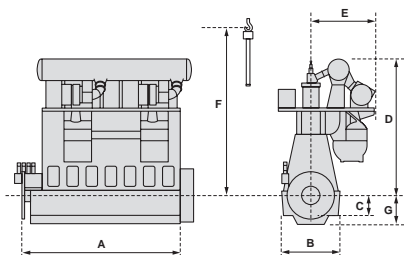
Cyl.	Output in kW at				Length A mm	Weight tonnes
	97/103 rpm		77 rpm			
	R1/R1+	R2/R2+	R3	R4		
4	10 640	8 000	8 440	6 360	5 895	270
5	13 300	10 000	10 550	7 950	7 000	325
6	15 960	12 000	12 660	9 540	8 110	377
7	18 620	14 000	14 770	11 130	9 215	435
8	21 280	16 000	16 880	12 720	10 320	482
Dimensions	B	C	D	E	F*	G
mm	4 200	1 360	9 580	3 915	11 670	2 110

Brake specific fuel consumption (BSFC) in g/kWh

Full load					
Rating point		R1/R1+	R2/R2+	R3	R4
BMEP, bar		20.5/19.3	15.4/14.5	20.5	15.4
BSFC	Standard Tuning	167.0/166.0	160.0	167.0	160.0

Part load, % of R1/R1+	85	70	85	70	65
RT-flex tuning variant	Standard	Standard	Delta	Delta	Low-Load
BSFC	163.4/162.4	163.0/162.0	162.7/161.7	161.5/160.5	158.2/157.4

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ X52

Cylinder bore	520 mm
Piston stroke	2315 mm
Speed	79-105 rpm
Mean effective pressure at R1/R1+	21.0 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMk700

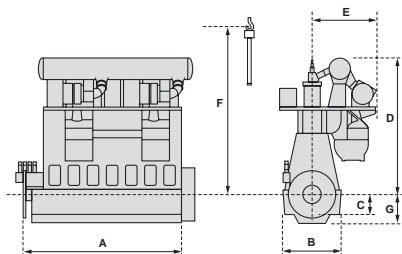
Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	105 rpm		79 rpm			
	R1/R1+	R2/R2+	R3	R4		
4	7 240	5 440	5 440	4 080	4 970	184
5	9 050	6 800	6 800	5 100	5 910	217
6	10 860	8 160	8 160	6 120	6 850	251
7	12 670	9 520	9 520	7 140	7 790	288
8	14 480	10 880	10 880	8 160	8 730	323
Dimensions	B	C	D	E	F	G
mm	3 495	1 205	8 444	2 146	10 150	1 866

Brake specific fuel consumption (BSFC) in g/kWh

Full load						
Rating point		R1	R2	R3	R4	
BMEP, bar		21.0	15.8	21.0	15.8	
BSFC	Standard Tuning	167.0	160.0	167.0	160.0	
Part load, % of R1/R1+		85	70	85	70	65
RT-flex tuning variant		Standard	Standard	Delta	Delta	Low-Load
BSFC		163.4	163.0	162.7	161.5	158.2

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ X40

Cylinder bore	400 mm
Piston stroke	1770 mm
Speed	124-146 rpm
Mean effective pressure at R1	21.0 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMK700

Rated power, principal dimensions and weights

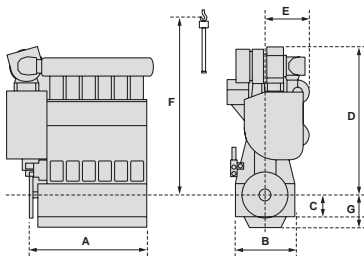
Cyl.	Output in kW at				Length A mm	Weight tonnes
	146 rpm		124 rpm			
	R1	R2	R3	R4		
5	5 675	4 550	4 825	4 550	5 107	109
6	6 810	5 460	5 790	5 460	5 807	125
7	7 945	6 370	6 755	6 370	6 507	140
8	9 080	7 280	7 720	7 280	7 207	153
Dimensions mm	B	C	D	E	F*	G
	2 610	950	6 335	1 660	7 635	1 425

Brake specific fuel consumption (BSFC) in g/kWh

Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		21.0	16.8	21.0	19.8
BSFC	Standard Tuning	174.0	168.0	174.0	172.0

Part load, % of R1	85	70	85	70	60
RT-flex tuning variant	Standard	Standard	Delta	Delta	Low-Load
BSFC	170.4	170.0	169.7	168.5	165.6

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ X35

Cylinder bore	350 mm
Piston stroke	1550 mm
Speed	142-167 rpm
Mean effective pressure at R1	21.0 bar
Fuel specification (Fuel oil)	700 cSt/50°C / ISO-F 8217:2005 / category ISO-RMK700

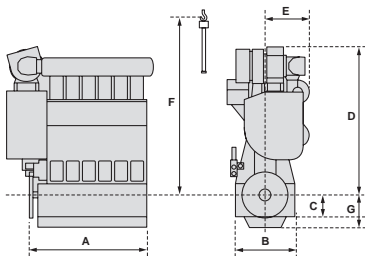
Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	167 rpm		142 rpm			
	R1	R2	R3	R4		
5	4 350	3 475	3 700	3 475	4 398	74
6	5 220	4 170	4 440	4 170	5 010	84
7	6 090	4 865	5 180	4 865	5 622	95
8	6 960	5 560	5 920	5 560	6 234	105
Dimensions mm	B	C	D	E	F	G
	2 284	830	5 556	1 605	6 736	1 326

Brake specific fuel consumption (BSFC) in g/kWh

Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		21.0	16.8	21.0	19.8
BSFC	Standard Tuning	175.0	169.0	175.0	173.0
Part load, % of R1		85	70	85	70
RT-flex tuning variant		Standard	Standard	Delta	Delta
BSFC		171.4	171.0	170.7	169.5
					166.6

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ 2 ストローク 低圧デュアルフューエルエンジン

WÄRTSILÄ 2-stroke low-pressure dual-fuel engine "X-DF"

X-DF エンジンの特長

Advantage of X-DF Engine

1. 予混合・希薄燃焼式を採用、SCR や EGR なしに IMO Tier III 規制値をクリア。

X-DF applies the pre-mixed lean burn technology and can meet IMO Tier III requirement without the exhaust gas after-treatment.

2. 高圧コンプレッサ等を必要とせず、初期投資費用や運航費用を抑制。

X-DF has advantages of lower Capex and Opex due to no requirement of a high pressure compressor.

3. 低い圧力の LNG(16bar 以下) を利用し、安全性が高い。

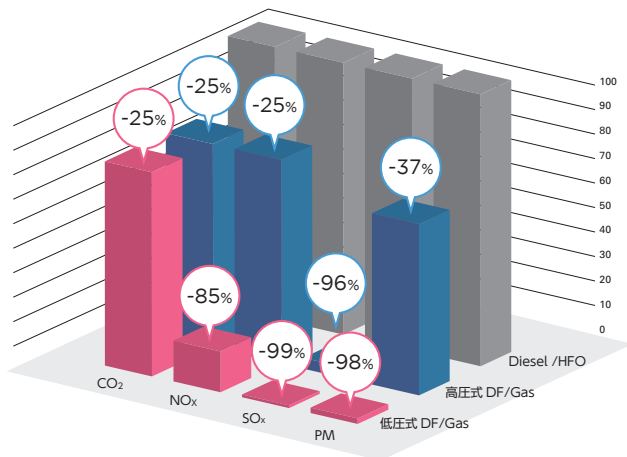
For safety concerns, X-DF uses low-pressure LNG. (<16 bar)

4. ガスモードからディーゼルモードへ、瞬時に切り替え可能。

X-DF can switch from gas mode to diesel mode immediately.

5. 大型船舶用主機として実績のある、低速 2 ストロークエンジンでの実現

X-DF is based on the low-speed two-stroke engine which is much proven in marine use.



X-DF エンジンの構造

Structure of X-DF engine

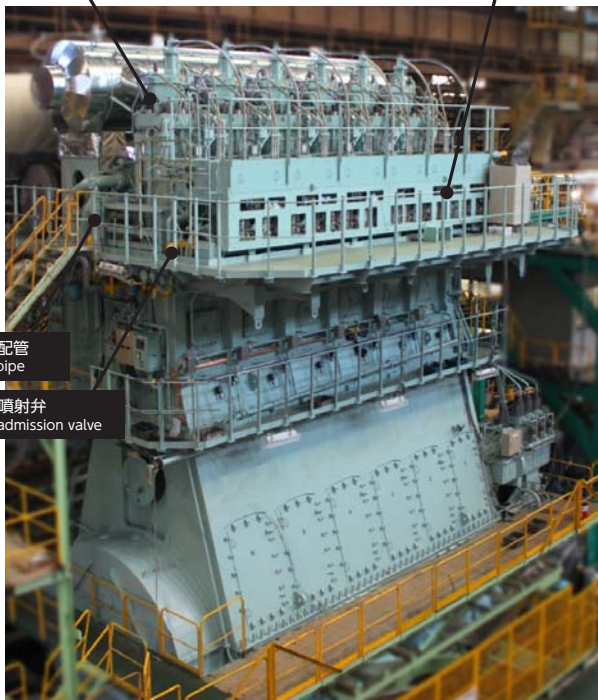
パイロット噴射弁
Pilot fuel injection valve

予燃焼室
Pre-combustion chamber

UNIC 制御モジュール
UNIC control module

ガス配管
Gas pipe

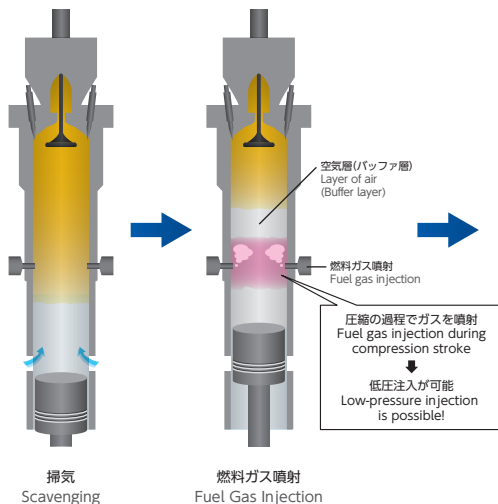
ガス噴射弁
Gas admission valve



W6X72DF

X-DF の原理

Operating Cycle



燃料ガス噴射

Fuel gas injection

本方式はピストン圧縮によって燃焼室内圧力が上昇する前に、燃料ガスの噴射を完了するため、燃料ガスを高圧にする必要がありません。

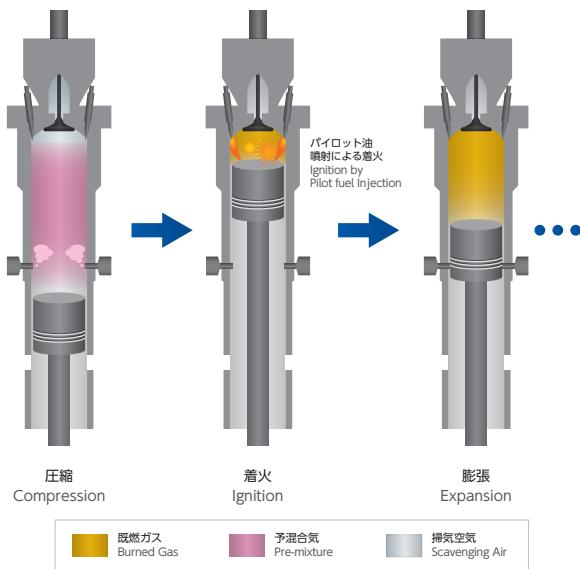
Since fuel gas injection is finished before the cylinder pressure increases.
High pressure gas injection is not needed.

着火・燃焼

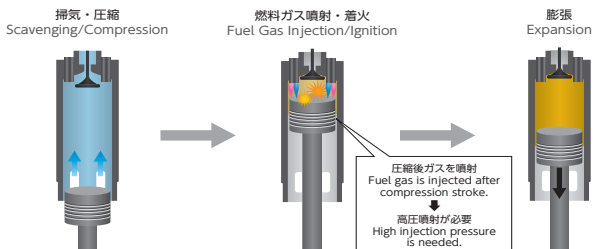
Ignition/Combustion

NO_x 低減のためには希薄な予混合気を燃焼させる必要がありますが、希薄予混合気は着火し難いという特性があります。そこで、上死点近傍で極微量のパイロット燃料を噴霧することにより、希薄予混合気への安定した着火を実現させています。

Low NO_x can be achieved by lean burn technology. The lean pre-mixture is poor ignitable but can be ignited by a small quantity of pilot fuel oil at the end of compression.



ディーゼル（拡散）燃焼方式 Diesel (Diffusive) Combustion System



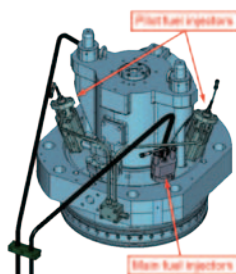
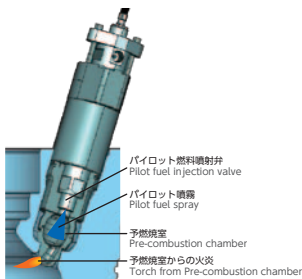
X-DF を支える技術

Key technology of X-DF

パイロット着火技術

Micro pilot and Pre-chamber technology

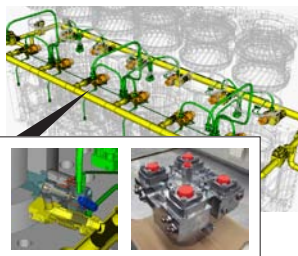
- ディーゼルモード用の液体燃料弁の他に、パイロット燃料噴射弁を設置
Pilot fuel injection valves are installed as well as Fuel injection valve for diesel operation.
- コモンレールテクノロジーを採用
Common-rail technology also applied.
- 噴射量はわずか 1%* *R1 最高出力時における投入エネルギー量に対する割合
Pilot fuel quantity of 1% of heat release*. *Supplied energy percentage at R1 rating point.
- 安定した燃焼性と低 NOx を両立
Stable combustion and low NOx are achieved.



ガス噴射弁 (GAV)

Gas Admission Valve

- 1 シリンダにつき 2 つのガス噴射弁を装備
2x GAV per cylinder at mid stroke of cylinder liner
- ガス噴射弁は排気駆動用と同じサーボオイルにて駆動
GAV actuated by servo oil same as exhaust valve driving
- 全負荷からアイドリングまで正確なガス供給を最適に制御
Flexible gas admission control from 'idling' to full load
- 二重ガス配管による高い安全性
Double-walled piping for enhanced safety



船内プラント構成の例

Fuel supply system arrangement for vessel

LNG 運搬船向けのプラント構成例

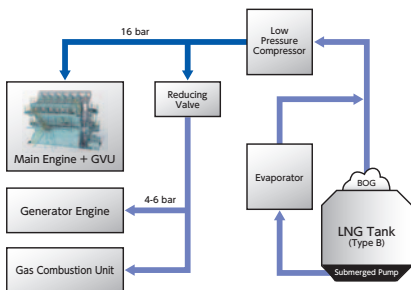
For LNG carrier

低圧式のコンプレッサで BOG を加圧して燃料ガスとして供給。

燃料供給システムは省電力で、運航コストを抑えることが可能。

BOG is used as the fuel gas of Main Engine and Generator Engine.

This system need low energy consumption so that operating costs are reduced.

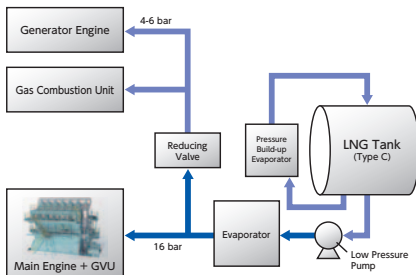


一般商船向けのプラント構成例

For merchant vessel

加圧式の燃料タンク (Type C) を採用。燃料供給システムをシンプルかつ経済的にできます。

In case of using LNG tank type C, this system is simple and economical.



WÄRTSILÄ X82DF

Cylinder bore	820 mm
Piston stroke	3375 mm
Speed	65-84 rpm
Mean effective pressure at R1	17.3 bar

Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	84 rpm		65 rpm			
	R1	R2	R3	R4		
6	25 920	21 600	20 070	16 710	11 045	805
7	30 240	25 200	23 415	19 495	12 550	910
8	34 560	28 800	26 760	22 280	14 055	1 020
9	38 880	32 400	30 105	25 065	16 500	1 160
Dimensions	B	C	D	E	F*	G
mm	5 320	1 800	12 250	5 400	14 820	2 700

Brake specific gas consumption (BSGC) in g/kWh

Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	138.7	139.7	138.4	139.3

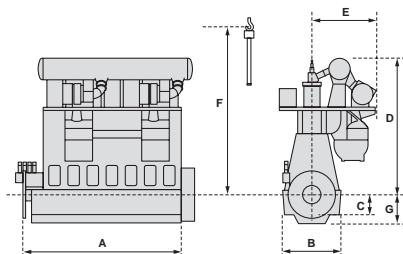
Brake specific Pilot fuel consumption (BSPC) in g/kWh

Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	1.3	1.6	1.7	2.0

Brake specific fuel consumption (BSFC) in g/kWh

Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	179.1	179.1	179.1	179.1

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ X72DF

Cylinder bore	720 mm
Piston stroke	3086 mm
Speed	69-89 rpm
Mean effective pressure at R1	17.3 bar

Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	89 rpm		69 rpm			
	R1	R2	R3	R4		
5	16 125	13 425	12 500	10 400	8 085	481
6	19 350	16 110	15 000	12 480	9 375	561
7	22 575	18 795	17 500	14 560	10 665	642
8	25 800	21 480	20 000	16 640	11 960	716
Dimensions	B	C	D	E	F*	G
mm	4 780	1 575	10 790	4 710	13 560	2 455

Brake specific gas consumption (BSGC) in g/kWh

Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	139.4	140.4	139.0	139.9

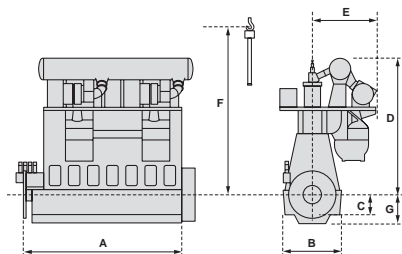
Brake specific Pilot fuel consumption (BSPC) in g/kWh

Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	1.4	1.7	1.8	2.2

Brake specific fuel consumption (BSFC) in g/kWh

Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	180.2	180.2	180.2	180.2

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ X62DF

Cylinder bore	620 mm
Piston stroke	2658 mm
Speed	80-103 rpm
Mean effective pressure at R1	17.3 bar

Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	103 rpm		80 rpm			
	R1	R2	R3	R4		
5	11 925	9 925	9 250	7 700	7 000	325
6	14 310	11 910	11 100	9 240	8 110	377
7	16 695	13 895	12 950	10 780	9 215	435
8	19 080	15 880	14 800	12 320	10 320	482
Dimensions	B	C	D	E	F*	G
mm	4 200	1 360	9 580	3 915	11 670	2 110

Brake specific gas consumption (BSGC) in g/kWh

Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	139.2	140.2	138.8	139.7

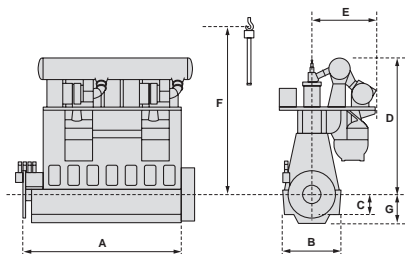
Brake specific Pilot fuel consumption (BSPC) in g/kWh

Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	1.6	1.9	2.1	2.5

Brake specific fuel consumption (BSFC) in g/kWh

Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	180.2	180.2	180.2	180.2

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ X52DF

Cylinder bore	520 mm
Piston stroke	2315 mm
Speed	82-105 rpm
Mean effective pressure at R1	17.3 bar

Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	105 rpm		82 rpm			
	R1	R2	R3	R4		
5	7 450	6 200	5 825	4 850	5 950	217
6	8 940	7 440	6 990	5 820	6 900	251
7	10 430	8 680	8 155	6 790	7 850	288
8	11 920	9 920	9 320	7 760	8 800	323
Dimensions	B	C	D	E	F*	G
mm	3 495	1 205	8 444	2 146	10 150	1 866

Brake specific gas consumption (BSGC) in g/kWh

Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	140.8	141.7	140.3	141.1

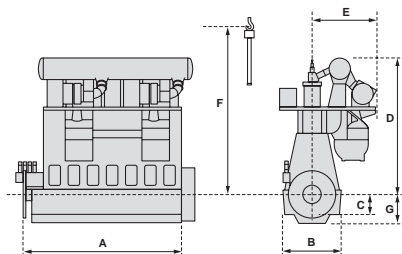
Brake specific Pilot fuel consumption (BSPC) in g/kWh

Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	2.0	2.4	2.5	3.0

Brake specific fuel consumption (BSFC) in g/kWh

Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	182.3	182.3	182.3	182.3

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ RT-flex50DF

Cylinder bore	500 mm
Piston stroke	2050 mm
Speed	99-124 rpm
Mean effective pressure at R1	17.3 bar

Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	124 rpm		99 rpm			
	R1	R2	R3	R4		
5	7 200	6 000	5 750	4 775	5 576	200
6	8 640	7 200	6 900	5 730	6 456	225
7	10 080	8 400	8 050	6 685	7 336	255
8	11 520	9 600	9 200	7 640	8 216	280
Dimensions	B	C	D	E	F*	G
mm	3 150	1 088	7 646	3 570	9 270	1 636

Brake specific gas consumption (BSGC) in g/kWh

Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	140.8	141.6	140.3	141.1

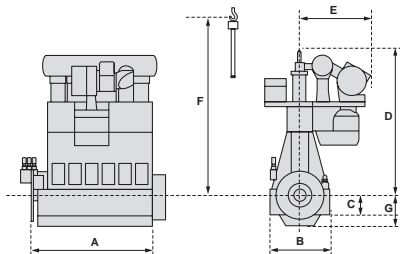
Brake specific Pilot fuel consumption (BSPC) in g/kWh

Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	2.0	2.4	2.5	3.0

Brake specific fuel consumption (BSFC) in g/kWh

Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	182.3	182.3	182.3	182.3

* Standard piston dismantling height can be reduced with tilted piston withdrawal.





<http://www.ihl.co.jp/du/>

当社ウェブサイトにて、最新情報や技術資料をいつでもご覧いただけます。

The updated information and latest technical materials
on our website can be viewed at anytime.

統合保守支援システム LC-A

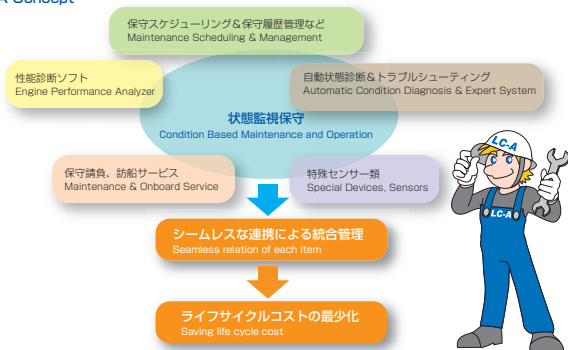
LifeCycle Administrator

RT-flex 電子制御エンジンには多くのセンサーが装備されていることから、エンジンの各種情報を細かく把握することができます。オプションの LC-A サービスパッケージを組み合わせれば、効率運航、主機関の予防保全を行うことができ、本船のライフサイクルに渡って、より安全運航に寄与し、また、コスト低減に貢献いたします。

Various information on the engine can be found in detail from a lot of sensors on RT-flex electronically controlled engines. In combination with LC-A service package, it contributes to save the lifecycle cost by preventive maintenance and optimum operation setting, and to safety operation.

LC-A のコンセプト

LC-A Concept



期待される導入メリット

Expected advantage

- ・ 最適な設定によるオペレーションコストの削減
Saving operating cost by optimum setting
- ・ 自動診断や CBM などによる省力化
Labor-saving by automatic diagnosis CBM etc.
- ・ 統一された情報管理による書類業務の削減
Reduction of document works by unified information management
- ・ 異常発生時の復旧時間の縮小
Reduction of recovery time when some abnormality happened
- ・ 予期しない off-hire の減少
Less unexpected off hire
- ・ 良い状態を維持することで中古市場での船舶価値の向上
Keeping good condition and increasing vessel value in used market

1. 保守管理と予防保全

Condition Based Maintenance & Preventive Maintenance

- 自動状態診断システムは、関連する測定結果、検査結果に基づき状態指数を算出します。

Automatic condition diagnosis system calculates Condition index by related measurements and inspection results according to developed logic.

- 状態指数がある値を超えた場合、警告を示すと同時に、トラブルシューティングのためにエキスパート・システムに情報を送ります。If Condition index is over the certain value, the system shows warning on PC screen and sends the information to Expert system for troubleshooting.

- 状態指数は、予防保全システムと保守管理システムからも参照し、オーバーホールの時期や検査の最適化にも使用されます。

Condition index is sent to Preventive maintenance system and Maintenance management system for optimization of inspection or overhaul timing.

自動状態診断 Automatic condition diagnosis



2. 最適オペレーションの設定

Condition Based Optimum Operation Setting

- 自動状態診断システムは、各部の状態指数を算出します。

Automatic condition diagnosis system calculates Condition index of each part.

- 最適運転システムは算出された状態指数などにに基づき、注油率や燃料噴射タイミングなどの最適設定値を算出します。

Optimized operation system calculates and shows optimum value of each settings, according to Condition indexes and developed logic.



予防保守

Preventive maintenance

- 傾向診断
Trend diagnosis
- メンテナンス予測
Maintenance prediction
- その他
Etc.

最適なオペレーション

Optimized operation

- 最適なシリンダ注油量
Optimum cylinder oil feed rate
- 最適な噴射時期
Optimum injection timing
- その他
Etc.

統合保守支援システム LC-A

LifeCycle Administrator

3. トラブルシューティング

Troubleshooting

- エキスパートシステムは異常情報を検知すると、各種測定値などの情報に基づき、自動的に推定故障部品、要因をリストアップします。

When Expert system receives information of abnormality, then it lists up estimated failure parts and factor automatically.

- 推定故障部品、要因が何処であるかをイラスト上に示すとともに、その写真を表示します。

Expert system indicates where the parts are installed on engine with picture.

- 対応するチェックと復旧作業のための作業要領書を抽出、表示します。

Expert system shows special instructions for checking and recovery work.

- 対応する取扱説明書、コードブックを抽出、表示します。

Expert system shows relative instruction manuals and code book, too.

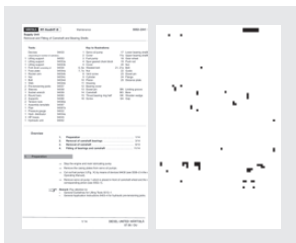
迅速な復旧 Quick recovery



エキスパートシステム Expert system

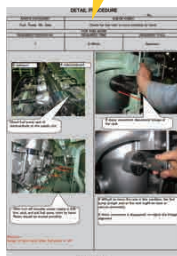
- トラブルシューティング
Troubleshooting
- 修理方法
How to repair
- その他
Etc.

多くの写真付きで、
非常に分かりやすくて要領書
Very plain instruction with many pictures.



通常の取扱説明書

Related standard instruction, code book, etc.



チェックと復旧作業のための作業要領書
Special instructions for checking
and recovery work

4. 保守管理

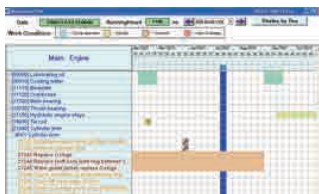
Maintenance Management

1. 保守管理システムで管理するもの
Managing following information

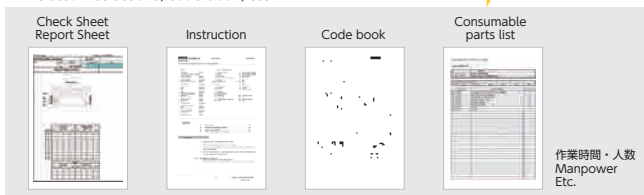
- 保守、検査スケジュール
Maintenance and inspection schedule
- 保守、検査結果とレポート作成補助、履歴管理
Inspection results and reports
- その他 Etc.

2. 保守管理システムで得られる情報
Showing following information

- 保守作業による消耗部品
Consumable parts by maintenance work
- 関連する取扱説明書、コードブックなど
Related instructions, code book, etc.



作業に必要な情報を自動抽出
Distilling related instructions for work



5. 各機能の連携

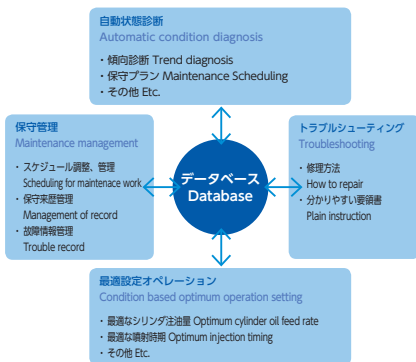
Seamless Combination

- 各機能は単一のデータベースにて情報を共有しており、各機能のシームレスな連携が確立されています。

As for each function, information is shared by a data base, and seamless cooperation of each function can be established.

- 容易な操作で的確な情報を提示します。

The accurate information can be shown by an easy operation.



CMAXS LC-A

ClassNK コンサルティングサービスとの共同によって LC-A を発展させ、CMAXS LC-A を統合サポートプラットフォームとし、船内にある各機器の一元管理を可能としました。

CMAXS LC-A is developed based on LC-A support system together with Class NK Consulting Service. It can manage machines on board as the integrated platform.

特長

Features

1. 船内の各機器に対して CMAXS LC-A の機能（状態診断、トラブルシューティング、保守管理など）を適用可能。これにより、機器毎に異なるシステムを導入する必要がありません。

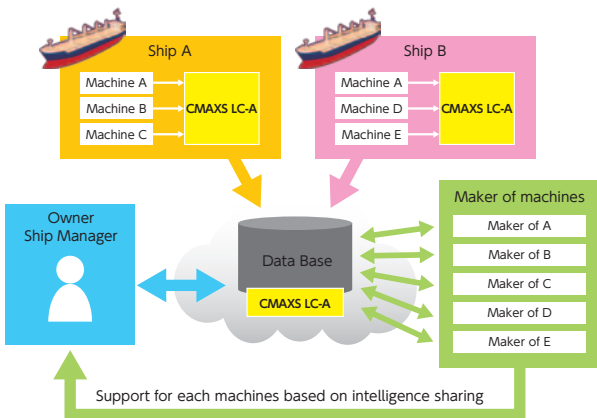
Each machine can apply CMAXS LC-A functions (condition diagnosis, trouble shooting, maintenance management etc). It is not necessary to introduce the different system depending on machine.

2. 各船の情報は陸上のサーバーにて一括管理されます。

All data from the ship is stored in management server at shore side.

3. 船主 / 管理会社と機器メーカーが情報を共有することで円滑かつ確かなサポートを可能とします。

Smooth and accurate support is achieved by intelligence sharing between owner/ship manager and manufactures.



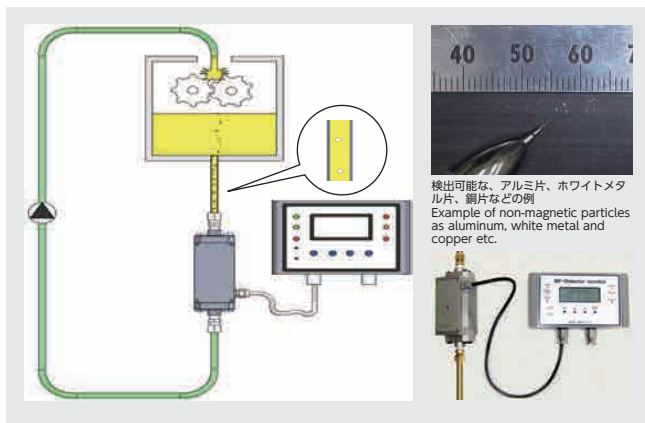
MF-Detector

Metal Fragment Detector

MF デテクター（導体片検出装置）は、LO 中の微小導体片を連続的に計測するためのセンサーです。鉄などの磁性金属だけでなく、ホワイトメタルやケルメットなどの非磁性材料の微小な片（0.4mm 程度）の発生を常時監視することが可能で、機器からの潤滑油戻り（出口）系統に MF デテクターを設置することにより、軸受、歯車などの損傷を早期に発見することが可能となります。

MF-Detector is the metal particle detector. MF-Detector can monitor not only magnetic particles as iron but also non-magnetic particles as white metal, aluminum, copper etc, and detectable minimum particle size is about 0.4mm.* So, when MF-Detector is installed on lubrication oil line, it can find damage of parts as gear, bearing etc. at early stage.

* Detectable size varies depending on material, shape of particle, flow speed etc.



MF-Detector モニターは、MF-Detector で検知した異物を「大」、「中」、「小」のサイズ別にカウントします。それぞれのサイズ毎に、あらかじめ設定した一定時間あたりの検知数の閾値を超えた場合は、「警告」、「警報」信号を出力することができます。

標準モニターは、記録機能がありません。記録機能付モニターは、オプションとなります。

MF-Detector monitor counts detected signal from MF-Detector by the size as small, middle and large. Set point of detected number and monitoring time can be set on the monitor, and if detected number is over than set point, monitor makes caution and alarm.

Portable TF-Detector

Trace of Ferrous powder Detector

高分解能磁性粉濃度測定装置

Very sensitive magnetic particle detector with high resolution.



高精度な鉄分濃度の計測

High sensitivity and resolution

大きさが数ミクロン程度の磁性粉をも測定できるので、異常磨耗を早期に発見することができます。

TF-Detector examines magnetic particles of a size down to a few micro-meters with resolution of less than 5ppm. So, you can find out abnormal wear at very early stage.

大型船用ディーゼルエンジンへの適用例

Typical application to two stroke low speed engine

シリンダドレン油中の磨耗粉を定期的に計測することにより、ピストンの摺動状態を把握することができます。

ピストンの摺動状態に応じてシリンダ油量を調整することにより、シリンダ油の消費量を抑えることができます。

また、ピストンの摺動異常を極早期発見でき、早い段階で対処することで深刻な損傷を回避することが可能です。

You can monitor piston running condition through periodical measurement of friction powder content in cylinder drain oil by TF-Detector, and then,

- You can save cylinder oil consumption by optimized feed rate setting according to piston running condition.
- You can catch a foretaste of abnormal piston running condition, and then you can take actions to avoid serious damage at very early stage.



操作が簡単

Easy operation as 1-2-3

1. 試験管に少量の油を採取する。

Sample small amount of oil in a glass tube.

2. 試験管を TF-Detector にセットする。

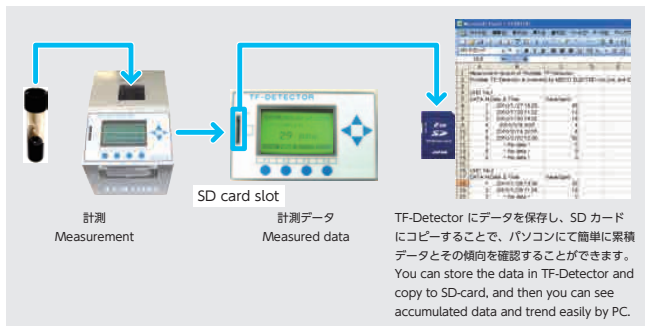
Set a glass tube to TF-Detector.

3. 計測ボタンを押すと、20 秒後以内に鉄粉濃度が表示される。

Press button, then TF-Detector shows the magnetic particle density in 'ppm' within 20 seconds.

[SAVE] ボタンを押せば、日時と共に計測データを保存できます。480 データ (24 ユニット × 20 データ) を保存可能で、SD カードに保存データをコピーすることも可能です。

If you want, you can save the measurement data with date and time by pressing [SAVE] button. Portable TF-Detector has memory for 480 data (24 unit x 20 data), and you can copy the data to SD-card for PC.



常時遠隔監視を可能とするオンラインタイプもあります。

On-line type is also available. You can remotely monitor the magnetic particle density in the oil, continuously.



* TF-Detector はディーゼルユナイテッドと明陽電機の共同開発品であり、特許取得いたしました。

* DU and MEIYO received a patent for new technologies of TF-Detector.



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